Name of Organization: USACE Research and Development Center

Type of Organization: Federal Agency

Contact Information: Mr. Jeffrey Talley

Environmental Laboratory

3909 Halls Ferry Road (ATTN:CEWES-EE-R)

Vicksburg MS 39180

Phone: (800) 522 - 6937 **Extension:** 2856

Fax: (601) 634 - 4844

E-Mail: talleyj@wes.army.mil

Project Title: Investigation of Beneficial Reuse of Dredged Material

Project Category: Contaminated Sediments

Rank by Organization (if applicable): 0

Total Funding Requested ($): 275,000 **Project Duration:** 2 Years

Abstract:

The reuse of dredged sediment as reclaimed soil will extend the operational life of confined disposal facilities (CDF) while benefiting the environment through reclamation of topsoil. However, dredged harbor sediments contaminated with polycyclic aromatic hydrocarbons [PAHs] and polychlorinated biphenyls [PCBs] face very stringent cleanup standards prior to reuse. This is a serious impediment for reuse of dredged materials. There is a growing awareness among both practitioners and regulators that soil and dredged material cleanup levels should be more site-specific, as determined by actual contaminant availability and risk. However, adequate tools to evaluate and understand contaminant availability in dredged materials are lacking; thus, conservative, low-level cleanup standards are invoked. The objective of this work is to investigate at the particle and sub-particle scale, the locations, associations, and availability of PAHs and PCBs in reclaimed dredged material processed through field composting biotreatment. The information will be used to assess more directly how the contaminants are bound to component particles and whether the material following field composting treatment exhibits much reduced contaminant availability. The research will employ various physical, chemical, and biological measurements in combination to answer the question of how and where PAHs and PCBs are bound on dredged material following field composting operations and how this relates to the contaminants being more or less available as evidenced by accumulation in earthworms.

Geographic Areas Affected by the Project

States:

- [ ] Illinois
- [ ] Indiana
- [x] Michigan
- [ ] Minnesota
- [ ] New York
- [ ] Pennsylvania
- [x] Wisconsin
- [ ] Ohio

Lakes:

- [ ] Superior
- [ ] Huron
- [x] Michigan
- [ ] Erie
- [ ] Ontario
- [ ] All Lakes

Geographic Initiatives:

- [ ] Greater Chicago
- [ ] NE Ohio
- [ ] NW Indiana
- [ ] SE Michigan
- [ ] Lake St. Clair

Primary Affected Area of Concern: Milwaukee Estuary, WI

Other Affected Areas of Concern: Green Bay, WI

For Habitat Projects Only:

Primary Affected Biodiversity Investment Area:

Other Affected Biodiversity Investment Areas:

Problem Statement:

The reuse of dredged sediment as reclaimed soil will extend the operational life of confined disposal facilities (CDF) while benefiting the environment through reclamation of topsoil (Bowman, 1999). However, dredged harbor sediments contaminated with polycyclic aromatic hydrocarbons [PAHs] and polychlorinated biphenyls [PCBs] face very stringent cleanup standards prior to reuse. This is a serious impediment for reuse of dredged materials. In Wisconsin certain PAH contaminants must be cleaned up to as low as 8.8 parts per billion [ppb] and PCBs must be as low as 0.05 ppb. These levels are practically unachievable using bioreclamation technologies. Thus, relatively low-cost, natural cleanup processes like composting may not meet cleanup standards. These low-level cleanup standards assume that the PAHs and PCBs are readily available and may result in environmental exposure. There is a growing awareness among both practitioners and regulators that soil and dredged material cleanup levels should be more site-specific, as determined by actual contaminant availability and risk. However, adequate tools to evaluate and understand contaminant availability in dredged materials are lacking; thus, conservative, low-level cleanup standards are invoked. Consequently, cleanup is driven by total contaminant mass removal rather than what should be cleaned up to be environmentally protective.

Proposed Work Outcome:

The objective of this work is to investigate at the particle and sub-particle scale, the locations, associations, and availability of PAHs and PCBs in reclaimed dredged material processed through field composting biotreatment. The information will be used to assess more directly how the contaminants are bound to component particles and whether the material following composting treatment exhibits much reduced contaminant availability.

The research will employ various physical, chemical, and biological measurements in combination to answer the question of how and where PAHs and PCBs are bound on dredged material following field composting operations and how this relates to the contaminants being more or less available as evidenced by accumulation in earthworms.
This work builds on recent and concurrent studies on PAHs in dredged material obtained from the Jones Island CDF (Ghosh et al., 2000). This work has shown that:

1. PAHs are unequally distributed by particle type;

2. different particle types have much different binding energies and release rates for PAHs;

3. bioslurry treatment selectively removes PAHs from clays and silts leaving a residual that is strongly bound on coal-derived particles; and

4. though only a certain fraction of the total amount of the PAHs in the dredged material was remediated by bioslurry treatment, there was a very significant environmental benefit as shown by reduction in PAH accumulation in earthworms.

We propose to extend these investigations to support field demonstration of composting treatment for dredged material. We will use PAH-contaminated dredged material from Milwaukee, WI, and PCB-contaminated materials from Green Bay, WI. These materials were processed in DOER-sponsored demonstration projects during summer 1999. The questions that we will answer are:
1. For the residual PAHs and PCBs remaining after composting, what are the contaminant distributions by particle size and type?
2. What are the release rates and activation binding energies for residual PAHs and PCBs after composting treatment? How does this depend on particle types?
3. What is the potential for accumulation of residual PAHs and PCBs in earthworms and how does this depend on the locations and binding of the contaminants by particle type?
4. What are the implications of the particle and sub-particle scale observations for decision making on risk management and reuse of dredged material?

We will answer these questions using a set of unique analytical techniques including double laser mass spectrometry to analyze PAHs and PCBs at the sub-particle scale; infrared microspectroscopy and wave dispersive x-ray analysis to assess the chemical environment where contaminants are located; and thermal programmed desorption mass spectrometry and aqueous desorption measurements to determine diffusive rates and activation energies. In addition, earthworm uptake tests will be conducted to relate changes in microscale observations to changes in biological uptake.

This work can help change the common perception that PAH and PCB contaminants in dredged material are readily available and pose risk. The findings will demonstrate exactly how the contaminants are bound to dredged material and help determine appropriate cleanup levels, which may be less restrictive than current standards but which are still protective. Ultimately the work will help substantiate the use of comparatively low cost and environmentally friendly composting treatments to reclaim contaminated dredged material and prolong the operational life of CDFs.

References:

Efforts to Develop Beneficial Uses for Dredged Material from the Milwaukee and Green Bay Confined Disposal Facilities. Report. David. A. Bowman. US Army Engineer District, Detroit, June 1999.

Microscale Location, Characterization, and Association of Polycyclic Aromatic Hydrocarbons on Harbor Sediment Particles. Ghosh, U., R. G. Luthy, J. Seb Gillette and R. N. Zare. Accepted for publication in Environmental Science & Technology, 2000.

Project Milestones:	Dates:
Project start	09/2000
Site study and sample procurement	12/2000
PCB/PAH location on sediment particles	06/2001
PCB/PAH release rates from composted sed	12/2001
TPD studies on composted sediment	03/2002
Earthworm toxicity tests	03/2002
Project end	09/2002
	/

☐ Project Addresses Environmental Justice

If So, Description of How:

☒ Project Addresses Education/Outreach

If So, Description of How:

This work will be conducted in close cooperation with the US Army Corp of Engineers, Detroit District's efforts to develop beneficial uses for dredged sediments from the Milwaukee and Green Bay confined disposal facilities. The research outcome will be shared with the Michigan Department of Natural Resources, and the Lake Michigan Forum for the purpose of sharing new findings and possible feedback and field implementation.

The described work would involve graduate students at Stanford University and students associated with Waterways Experiment Station thereby furthering educational goals related to the Great Lakes Research.

Conference presentation and peer reviewed publications will be used to disseminate the results of this project to the environmental engineering and science research and regulatory community. Activities of this research will be made available on the internet through the Waterways Experiment Station, Dredging Operations and Environmental Research website. Additionally, reports of this research will be integrated into reporting and outreach programs associated with the GLNPO and the SERDP office.

Project Budget:

	Federal Share Requested ($)	Applicant's Share ($)
Personnel:	100,000	50,000
Fringe:	40,000	20
Travel:	10,000	0
Equipment:	20,000	50,000
Supplies:	10,000	0
Contracts:	0	0
Construction:	0	0
Other:	0	0
Total Direct Costs:	180,000	100,020
Indirect Costs:	95,000	0
Total:	275,000	100,020
Projected Income:	0	0

Funding by Other Organizations (Names, Amounts, Description of Commitments):

1.Strategic Environmental Research and Development Program (DoD/DOE/EPA)
Title: Assessment and Prediction of Biostabilization of PAHs in Sediments.
Partners: USACE Waterways Experiment Station, Stanford University, and Naval Research Laboratory.
Leveraged amount: $275,000,

This research is focussed on developing microscale spectrometric and spectroscopic tools to identify the sub-particle scale locations and associations of PAHs on sediments to provide better understanding of sequestration mechanisms, sediment treatability and toxicity. Some of the fundamental scientific understandings from this work would be applied to the field in the current proposal using sediments from the Milwaukee Harbor CDF and Green Bay field sites.

Description of Collaboration/Community Based Support:

Co-PIs:

Dr. Richard G. Luthy and Dr. Upal Ghosh
Department of Civil and Environmental Engineering
Stanford University
Stanford, CA-94305-4020

Field support for this work will be provided by the following collaborators:

David W. Bowman, Detroit District, USACE-Detroit;
Lawrence E. Sullivan, Milwaukee Harbor Port Authority;
Dean Haen, Brown County Port and Solid Waste Department